TESTING THE RELATIONSHIP BETWEEN EXCHANGE RATE AND STOCK PRICE IN THE ASEAN COUNTRIES[1]

Dwipraptono Agus Harjito
Faculty of Economics, Universitas Islam Indonesia
e-mail: harjitok@yahoo.com

Abstract

The aim of this paper is to investigate the statistical relationship between stock prices and exchange rates in ASEAN from 1993–2006. Using Engle-Granger test, it finds that the relationship between stock prices and exchange rates is characterized by a feedback system, with Singapore Dollar as the dominant exchange rate. Johansen co-integration test finds that all of the stock prices and exchange rates are co-integrated. The results are supported by Vector Autoregression and Vector Error Correction Models. With respect to the relationship between stock prices and exchange rates, the results are inconclusive. The causality mostly runs from exchange rates to stock prices.

Keywords: Stock, exchange rates, ASEAN
JEL classification numbers: G11, G19

INTRODUCTION

Financial crisis in Asia since mid 1997 and global financial crisis in 2008 originated from the United States are believed to be caused by several factors, including a decline in currency values. Earlier part the Asian financial crisis was marked by a decline in the value of regional currencies against the US Dollar, which has already started since mid 1995. The situation is worsened by external influences such as the decline in export value since 1996 in the Asian region. This has led to disruption of financing the current account deficit and further led to the accumulation of short-term loans and the decline in currency values.

Initially, the increase in short-term loan by private sectors was not a problem as the exchange rate was stable and the performance of exports was enough to cover such loan. This became the problem when the economic performance decreased, accompanied by the decrease in the value of domestic currencies. Eventually, these led to financial crisis, which further decline the capability of private sectors to repay the loan.

The financial crisis in ASEAN was marked by the fluctuation in exchange rates and stock prices in each country. The relationship between exchange rates and stock price were strong in ASEAN, indicated by the high fluctuation in both variables. Fluctuation in stock price might cause capital flows which led to the fluctuation in exchange rates, or vice versa.

Some researches have been conducted to examine the relationship between exchange rates with stock prices. They have been focusing on finding the direction of the causality between exchange rates and stock prices. Research conducted by Phylaktis and Ravazzola (2002) shows the relationship between exchange rates and stock price indices in the UK. They find that the interaction between exchange rates and stock price index rise one last time because of lack of control on foreign capital, the application of the more flexible exchange rates and the emerging of capital markets in 2002. The fluctuation of exchange rates affects the competitiveness of a company, because it affects the value of revenue and

[1] This research is funded by the Indonesian General Directorate of High Education in 2008 as fundamental research grants

cost of capital and the fact that companies borrow from foreign countries to support their operations. On the other hand, the depreciation of local currency leads to an increase in export which further increases the cost faced by the company and its stock price. On the other hand, an appreciation of local currency reduces the profits for exporting firms because of lower foreign demand for its products.

The changes in exchange rates affect competitive power of a company through their impacts on return and capital costs. This has become the case since many companies borrow foreign funds to support their operations. On the other hand, depreciation in the domestic currencies increases the volume in their exports, which further increases returns obtained by the companies and also increases their stock prices. Eventually, the domestic currency will appreciate which will reduce the volume of exports.

A direct causal relationship between the closing stock prices and exchange rates is found in Abdalla and Murinde (1997). Meanwhile, Solnik (1984) find a weak positive relationship between differential of profit from stock with the exchange in real exchange value. He also finds that real growth in the stock market also has a positive effect on exchange rates.

This research uses financial data to predict stock prices. There is an evidence that the forecast of return from shares changes due to economic activities as measured by industrial production, real growth in gross domestic product (GDP), the value of labor, or corporate profits. Solnik (1984) argues that stock markets of Canada, France, Germany, Japan, Netherlands, England and the United States, representing more than ninety percent of the world's market capitalization, has a weak positive relationship between an equity interest differentials and exchange rate changes.

This study attempts to find an accurate causality between exchange rates and stock price indices in ASEAN. Exchange rate is selected as the first variable because it is the most commonly used variable to predict the value of the goods or to measure the economic welfare through the amount of rupiah per dollar, as the question what is the value of rupiah per dollar, an indicator of a country's economy (Harjito, 2006). Stock price is selected as the second variable because its share price will determine investors' decisions such as whether to invest in Indonesia or other countries in ASEAN.

This study intends to examine the relationship between exchange rates and stock prices in five ASEAN, namely Indonesia, Malaysia, Singapore, Thailand and the Philippines, using causality test procedure and co-integration. It tries to study the relationship between changes in exchange rates and stock prices in ASEAN from 1993 to 2006. It also addresses the question of whether the relationship between changes in exchange rates and stock prices prevails in the short or long terms.

Engle-Granger causality test examines the causal relationship between variables, whether the relationship is uni-directional or bi-directional in nature. Several empirical studies using Engle-Granger causality tests support the positive causal relationship from exchange rates to stock prices. This means that there is a positive uni-directional causal relationship from exchange rates to stock prices. The increase in currency exchange rates will raise the stock price. Bodnar and Gentry (1993) assert that there are three effects of exchange rate fluctuations on firm's value or cash flow. These include the impact of exchange rate on domestic exporters to compete with foreign exporters, input prices, and the company's assets measured in foreign currency. An increase in foreign exchange will increase the value of a company that realized with the increase in stock prices. There is also a reason to believe that changes in exchange rates will positively cause changes in stock prices. For example, at the micro level, the appreciation of a currency can depreciate the stock prices by reducing firm's profit (Jorion, 1990). The response of stock prices to exchange rate fluctuations may depend on the level of disclosure (exposure) meaning to the exchange rate risk, although this does not always indicate a strong relationship (Bodnar and Gentry, 1993). Aggarwal (1981) argues that changes in exchange rates may cause changes in stock price due to variations in exchange rates that change the company's profit, not only for multinational companies and export oriented companies, but also for domestic companies, and this affects the stock price. This implies that the instructions causality runs from exchange rates to stock prices.

In contrast, stock prices may also influence the fluctuations in exchange rates through money demand. Changes in stock prices lead to an increase demand for real money, and then affect the value of domestic currency (Ajayi et al. 1998). The stock price may be used to reflect the development of macroeconomic variables, such as expectations of real economic activity. Therefore, changes in stock prices can affect exchange rates (Solnik, 1984). Bahmani-Oskooee and Sohrabian (1992) find a bi-directional causality for the case in the United States. They find that the effect of stock prices to exchange rates and interest rates via an increase in real balances.

In addition, the increase in domestic stock prices will increase domestic wealth, and then the result is an increase in demand for money, and eventually an increase the interest rate. High interest rates cause capital inflows, resulting an appreciation of domestic currency (Krueger, 1983). Therefore, the causal relationship may also proceed from stock price to exchange rate. Many authors suggest that changes in price might disturb the equilibrium in money supply with regards to other assets in individual investment portfolio, as investors try to rearrange their portfolios of financial assets and real assets to a new balance. The rearrangement of portfolio, which includes the arrangement of stock price, is meant to adjust the new equilibrium level. On the other hand, there are other researchers who support the view that capital market has become the barometer for economic activities. The continuous movement in stock price, in general, shows the fluctuation in the economy which stimulate the growth of money, such as the activity to respond an increase in greater demand for loan. The increase in money demand will increase interest rae, which will leads to capital inflow, and eventually appreciate the domestic currency in terms of foreign currency. In other words, changes in stock price might influence capital inflow (outflow) to (from) a country to the others, which will eventually changes the exchange rates of domestic currency to the foreign ones.

Research carried out by Granger (2000) found that data from South Korea support the finding that changes in exchange rates cause changes in stock prices. The data from the Philippines shows that, based on the result from portfolio approach, stock price negatively influence exchange rates. The data from Hong Kong, Malaysia, Singapura, Thailand and Taiwan shows strong bi-directional causality, while the data from Indonesia and Japan fail to uncover any pattern. Doong and Yang (2005) find that stock price and exchange rates are not correlated. Using Engle-Granger causality test, bi-directional causality is detected in Indonesia, Korea, Malaysia and Thailand.

METHODS

This study intends to examine the relationship between exchange rates and stock prices in ASEAN-five (Indonesia, Singapore, Malaysia, Thailand and the Philippines) using causality test procedure and the co-integration. Data used in this study are weekly data from the exchange rates and stock prices of the ASEAN-five. The data are taken from the ASEAN-five, which have been published in newspapers, DataStream, or from the website. To achieve the objectives of this study, data analysis is conducted in two stages. The first stage uses an Engle-Granger causality test. This test is used to test how causality can occur between exchange rates and stock prices. The second stage is conducting co-integration test using Johansen co-integration test. The second test is used to test whether causality relationship between exchange rates and stock prices in ASEAN are effective for short or long terms. To support the second stage, the analysis continued by using analysis of Vector Autoregression (VAR), Impulse Response, and Vector Error Correction Model (VECM). Prior to conducting the tests mentioned above, data were tested by unit root to test the stationary of data.

Unit Root Tests

The preliminary step in this research focuses on determining the degree of integration in each variable. For this purpose, this research examines the presence of unit root at the elementary level (data level) and the first difference whether the data have been modified in the form of logarithms or in the form of percentage changes for each variable. The data from a stationary series must have the feature that the mean and covariance series does not depend on time. A serial data that is not stationary is called non-stationary data. Examples of data series that are non-stationary are random changes:

$$y_t = y_{t-1} + \varepsilon_t,$$

where ε_t is a stationary random changes of the disturbance. The data series y_t has a constant value of forecasts, the requirements for t, and variations that rose steadily over time. A random process is a difference stationary series because the first difference of y_t is stationary, namely:

$$y_t - y_{t-1} = (1-L)y_t = \varepsilon_t.$$

A difference of a stationary data series is said to be integrated is shown as $I(d)$, where d indicates the integration. State of integration is the number of unit roots contained in the data series, or the number of operations that makes a difference in these data become stationary. For the concept of random process above, there is one unit root series $I(1)$, in a way similar to a series of stationary $I(0)$. A formal method to test the serial data is the unit root test. This test examines the stationary of the data.

To conduct the test, this study uses the procedure which has been used by previous researchers, namely the Augmented Dickey-Fuller procedure (Dickey and Fuller, 1979).

Engle-Granger Causality Test

Engle-Granger causality test examine the direction of causality between variables. The possible outcomes are bi-directional, uni-directional, or no causality at all. Usually, regression analysis reflects only a mere relationship. However, Granger won the Nobel Prize by providing the possibility of bi-directional nature between two variables.

This study uses Engle-Granger causality test to analyze the relationship between exchange rates with stock prices. Engle and Granger (1987) states that when the time series data characterized by non-stationary, co-integration analysis is a statistical technique to match. In cases where there are two data series are integrated $I(1)$, the vector autoregression model (VAR) can be built to the original data (level) or at the level of the first difference with the addition of an error correction for the dynamic analysis of short-term and to reduce the possibility of a false causality.

Engle-Granger causality test assumes that the relevant information to predict exchange rates and stock prices subsequently used solely for time series data at variable exchange rates and stock prices.

The test is predicted by pair regression as follows:

$$Y_t = \alpha_0 + \sum_{i=1}^{m} \alpha_i Y_{t-i} + \sum_{i=1}^{m} \beta_i X_{t-i} + \varepsilon_t \qquad (1)$$

$$X_t = \gamma_0 + \sum_{i=1}^{m} \beta_i X_{t-i} + \sum_{i=1}^{m} d_i Y_{t-i} + \mu_t \qquad (2)$$

where *Y* is the stock price as measured in natural logarithm (ln) stock price index or the natural logarithm of the return on investment shares (of stock return, ln), *t* is the stock return period $((P_t - P_{t-1}) / P_{t-1}))$, P_t is the price of shares of period *t* and P_{t-1} is the stock price of *t*-1 period. Variable *X* is the real exchange rate as measured from the natural logarithm exchange rates or return the natural logarithm of the exchange rate in which the exchange rate of the period *t* return is $((Ex_t - Ex_{t-1})/Ex_{t-1})$, Ex_t is the period t of exchange rate and the Ex_{t-1} is the exchange rate of period *t*-1, whereas ε_t and μ_t is the average empty (zero-mean), that the series is not related to random error.

Hypothesis that exchange rates affect stock prices, if supported by the data, implies the null hypothesis should be rejected by calculating the value of *F*. If there is a bi-directional causality, the null hypothesis is rejected. To conduct the Granger causality test, *F*-statistic values are calculated based on the null hypothesis, which is in equation (1) and (2) with both coefficients *b* and *d* = 0. Because the results from Granger causality test is sensitive to the selection of lag length of time, the results are shown from the equations using the minimum final prediction error (FPE). This study uses the optimal lag for each variable. *F*-value is calculated as follows:

$$F_{(m,n-2m-1)} = \frac{(ESS_R - ESS_U)/m}{ESS^U/(n-2m-1)} \qquad (3)$$

where ESS_R and ESS_U are limited and unlimited sum of squared residuals for the regression of causality is limited and is not limited, respectively, *n* is the total number of observations and *m* is the number of lags of each variable.

Johansen Co-integration Test

Johansen co-integration test is an estimation of the co-integration and error correction mechanism that may separate the integration of long-term relationships with short-term. Therefore, the Johansen tests will determine whether the relationship between stock price changes and changes in exchange rates applicable to long-term and short term accurately. One of the basic unit root tests is that the researcher conducting Johansen co-integration test to see whether the combination of variables is also co-integrated.

Engle and Granger (1987) states that a linear combination of two or more non-stationary series might be stationary. If such a stationary, or *I*(0), linear combination exists, the two non-stationary time series are said to be co-integrated. The stationary linear combination is called the co-integrating equation and may be interpreted as a long-term equilibrium relationship between the variables (Harjito and McGowan, 2007). In this research, exchange rates and stock price co-integration may happen at the level of the first difference. Johansen (1988) states that if two variables are co-integration, then there must appear temporal causality in the Granger procedure to follow among the variables related. The result of this relationship is related at least in uni-directional. This suggests two important forces or channels that may cause changes in these variables. One channels indicates the response of one variable relates to change in other variables, which is viewed as the short-term interaction among these variables. The other channel shows the adjustment taken with a variable to correct any deviations from an equilibrium path (Ibrahim, 2000)

Vector Autoregression (VAR)

The vector autoregression (VAR) is generally used to forecast systems for interlocking relationships in the time series and to analyze the dynamic effects factor in a variable system. VAR approach requires a structural model by modeling each endogenous variable in the system as a function of lagged values of all exogenous variables in the system. Mathematical form of VAR is:

$$Y_t = A_t Y_{t-i} + \ldots + A_p Y_{t-p} + BX_t + \varepsilon_t \qquad (4)$$

where Y_t is the k vector of endogenous variables, X_t is a d vector of exogenous variables. A_1 …. A_p and B are the coefficient matrix for the estimates, and ε_t (error term) is the vector of innovations that may be correlated with each variable but not correlated with their own lagged values and uncorrelated with all variables that appear on the right equation.

This study says that the stock price (STOCK) and exchange rate (EXCH) jointly determined by two variables VAR and a constant only as an exogenous variable. With two lagged values of endogenous variables, the value of VAR is:

$$STOCK_t = a_{11}\, STOCK_{t-1} + a_{12}\, EXCH_{t-1} + b_{11} STOCK_{t-2} + b_{12}\, EXCH_{t-2} + c_1 + \varepsilon_{1,t} \qquad (5)$$

$$EXCH_t = a_{21}\, STOCK_{t-1} + a_{22}\, EXCH_{t-1} + b_{21} STOCK_{t-2} + b_{22}\, EXCH_{t-2} + c_2 + \varepsilon_{2,t} \qquad (6)$$

where a, b, c is the parameter estimates.

Some advantages of using vector autoregression as an analysis tool to find relationships between economic variables are: (1) This model is simple, so researchers do not need to distinguish in detail the variables used. (2) Simple estimate of where the OLS (Ordinary Least Square) can be implemented for different equality through separate ways. (3) Forecast results better than other, more complex models. (4) VAR analysis is also a very useful analytical tool, especially for understand the (5) Relationship between economic variables.

Vector Error Correction Model (VECM)

The Vector Error Correction Model (VECM) is limited from the VAR models that have a co-integration limits for building specifications, which are also designed to use non-stationary data of known and integrated. For example, there are two variables in a system with one co-integrating equation and no lagged difference. Co-integration equation is $Y_{2,t} = BY_{1,t}$ and its VEC model is:

$$\Delta Y_{1,t} = \gamma_1 (Y_{2,t-1} - BY_{1,t-1}) + \varepsilon_{1,t} \qquad (7)$$

$$\Delta Y_{2,t} = \gamma_2 (Y_{2,t-1} - BY_{1,t-1}) + \varepsilon_{2,t} \qquad (8)$$

In the example model, the only variable on the right side of the equation is error correction term. In this model, two endogenous variables $Y_{1,t}$, $Y_{2,t}$, has an average values different from zero (non-zero means) but the co-integration equation has a zero intercept.

RESULTS DISCUSSION

This study tests the causality between the exchange rate with the stock price index in ASEAN-five using Engle-Granger causality and of Johansen co-integration tests for the period of 1993 to 2006. The analysis begins by conducting unit root tests to determine the stationary of data. Once stationary at level data is known, analysis is continued to test the first and second hypotheses concerning the causality between exchange rates and stock prices with Engle-Granger causality test. The third hypothesis is whether the relationship between exchange rates and stock prices took place in the short term or long term, then tested on the subsequent analysis of test Johansen co-integration tests supported by the Vector Autoregression (VAR) and Test Vector Error Correction Mechanism (VECM). Some tests to determine the causality between exchange rates and stock prices above are as follows:

Unit Root Tests

Initial step in this analysis is to determine the degree of integration of each variable. The degree of integration is a measure to see if a variable has a data rate of the appropriate balance to be analyzed. Unit root tests are used to determine stationary or equilibrium data used in the analysis. Unit root test results are available in Table 1.

Table 1 shows the test of unit root for the percentage change (return data) for the exchange rate and stock price indices in the country of Indonesia, Thailand, Philippines, Singapore and Malaysia. The left side of the table shows the statistical testing for circuit-level data and the right side shows the test statistics for first differences of the data. Both the data level and first differences have been analyzed for the original data, the changed data into natural logarithms and the percentage difference data (the data exchange rate and stock return). This is meant for indicating that the data are stationary in the three types/levels of data.

Table 1: Unit Root Test

Variable	ADF test for level			ADF test for first difference		
	Original	**Log**	**Return**	**Original**	**Log**	**Return**
Indonesia:						
Exchange rate	-1.954	-0.812	-7.369***	- 5.718***	- 6.545***	-18.146***
Stock Index	-2.114*	-2.819**	-6.343***	-12.181***	- 13.452***	-14.236***
Thailand:						
Exchange rate	-0.812	-0.723	-7.886***	-13.721***	-14.241***	-16.714***
Stock Index	-0.721	-0.792	-8.758***	-13.453***	-13.153***	-15.670***
Philippines						
Exchange rate	0.122	-0.262	-8.912***	-15.626***	-16.381***	-14.713***
Stock Index	-1.326	-0.731	-8.247***	-13.153***	-13.257***	-14.294***
Singapore:						
Exchange rate	-0.734	-0.823	-7.561***	-15.230***	-15.132***	-15.251***
Stock Index	-2.117	-2.149*	-8.278***	-16.136***	-15.141***	-16.146***
Malaysia:						
Exchange rate	-0.729	-0.241	-7.471***	-14.217***	-13.832***	-16.517***
Stock Index	-1.702	-0.673	-6.812***	-14.951***	-10.783***	-16.195***

Notes: (1) *** indicates significant at 1% level, (2) ** indicates significant at 5% level, (3) * indicates significant at 10% level

As shown in Table 1 on the left side (data level), not all data from the five countries are significant for the type of original data (original) and the logarithm at 5% significance level. At 1% significance level, for the original data only happen in Indonesia alone, while for the logarithmic data in countries of Indonesia and Singapore. This means that if the data used is the original data or logarithmic data, that data is not stationary. In words, if we use 1% significance level, the null hypothesis of unit roots can not be rejected in the initial data (level) especially for this kind of original data and the logarithm. Meanwhile, non-stationary hypothesis can be rejected for the percentage change data in all variables for all countries at the 1% level of significance. That is, data that can be used for further analysis is primarily the percentage change data (return data). The right side of Table 1 shows that statistical hypothesis testing for non-equilibrium of the first difference of three types of data series can be rejected in all cases for all countries at the 1% level of significance. The results show that all data is balanced in the first difference. The result shows that the variables increase from the order of one, or $I(1)$. Thus, this study analyzes data in the form of income (return) for a test or other test of Engle-Granger causality test, Johansen co-integration, VAR, and ECM. However, other data types in the form of logarithms also analyze data on co-integration tests and VAR Johansen.

Engle-Granger Causality Tests

This study uses Engle-Granger causality test to analyze the relationship between stock prices and exchange rates in the ASEAN-five. Engle and Granger (1987) shows that when the time series were classified with non-stationary, co-integration is also in accordance with the analysis of statistical techniques. Table 2 shows the results of Granger Causality Test using logarithms and data acquisition (return) for the ASEAN-five. Each country's exchange rate is paired with the country's stock index and the stock index from other countries. This means for linking to stock indices and to find the causality relationship. For example, the rupiah/USD is paired with the Jakarta Composite Index (JSI), Thailand Composite Index (BSI), Manila Composite Index (MSI), Straits Time Index (STI), and Kuala Lumpur Composite Index (KLSI) sequentially. From the causality test, the results are found four alternative patterns of causality that can be observed, namely: (a) unidirectional causality from exchange rates affect stock prices, (b) unidirectional causality from stock prices to exchange rates, (c) two-way causality from exchange rate on stock prices and vice versa, and (d) there is no causality between exchange rates and stock prices.

The Thai Baht currency exchange rate does not influence the stock price indexes of other countries in the ASEAN-five, including it's own stock price index. However, the Thailand stock index positively influences Baht currency. Baht currency exchange rates actually affect the Philippines stock price index. Philippine peso also does not affect the stock price index in the countries of ASEAN. Peso currency only significantly influence the Jakarta stock price index (JSI) and Bangkok stock price index (BSI). The stock price index in Bangkok has bi-directional causality with Philippines peso.

Malaysian Ringgit does not significantly influence stock market index in ASEAN. There is evidence of unidirectional relationship, namely from Kuala Lumpur Stock Index to Malaysian Ringgit. This might be caused by the application of fixed exchange rate against US Dollar adopted in Malaysia.

Table 2: Result of Engle-Granger Causality Test

Variable	Logaritm Data		*Return* data	
	F-Statistic	Probability	F-Statistic	Probability
Indonesia:				
Rupiah – JSI	3.73223	0.02361**	12.1035	6.1E-06***
JSI – Rupiah	6.21567	0.00921***	6.31498	0.00612***
Rupiah – BSI	0.78341	0.50949	1.67251	0.21872
BSI – Rupiah	10.39811	1.2E-05***	8.29836	0.00025***
Rupiah – MSI	6.12833	0.00275***	4.43924	0.03236**
MSI – Rupiah	1.02371	0.18767	1.65187	0.18924
Rupiah – STI	10.17824	3.6E-05***	10.2186	1.6E-5***
STI – Rupiah	1.53875	0.45297	0.87354	0.49532
Rupiah – KLSI	11.11678	0.03461**	10.36531	4.7E-5***
KLSI – Rupiah	3.18765	0.46728	0.92964	0.39536
Thailand:				
Baht – BSI	0.81419	0.62923	1.28732	0.62865
BSI – Baht	4.78249	0.00218***	4.18731	0.00287***
Baht – JSI	2.82054	0.07298*	0.58921	0.45712
JSI – Baht	2.23409	0.36844	8.48738	0.00191***
Baht – MSI	2.78347	0.04627**	2.35829	0.07862*
MSI – Baht	0.55387	0.47851	2.18926	0.17636
Baht – STI	1.98351	0.38273	2.89637	0.27816
STI – Baht	0.56432	0.67321	0.54147	0.52938
Baht – KLSI	5.78112	0.03422**	1.81762	0.31782
KLSI – Baht	0.56287	0.87928	0.78366	0.78622
Philippines:				
Peso – MSI	3.13872	0.06252*	2.14531	0.78356
MSI – Peso	2.31124	0.09231*	2.32718	0.29818
Peso – JSI	7.65432	0.00093***	5.87328	0.00231***
JSI – Peso	0.34872	0.68273	2.52671	0.38762
Peso – BSI	2.68364	0.08763*	2.86273	0.78276*
BSI – Peso	8.45689	3.7E-05***	5.28374	0.01597**
Peso – STI	0.26718	0.62763	1.87260	0.42567
STI – Peso	1.98276	0.23982	0.97256	0.42676
Peso – KLSI	2.76535	0.08436*	1.04352	0.42686
KLSI – Peso	7.92887	3.98821	0.69833	0.42717
Singapore:				
Dollar Singapore - STI	8.76450	8.76450	11.1973	2.5E-03***
STI – Dollar Singapore	2.10027	2.10027	0.76253	0.51673
Dollar Singapore - JSI	5.47859	5.47859	5.43874	0.00083***
JSI – Dollar Singapore	0.57289	0.57289	0.27948	0.78475
Dollar Singapore - BSI	8.52876	8.52876	2.17836	0.08579*
BSI – Dollar Singapore	0.68971	0.68971	2.12983	0.06374*
Dollar Singapore - MSI	3.84754	3.84754	5.45968	0.00073***
MSI – Dollar Singapore	3.72637	3.72637	3.98385	0.03874**
Dollar Singapore – KLSI	8.87364	8.87364	8.98344	0.00053***
KLSI – Dollar Singapore	2.19736	2.19736	5.78377	0.03647**
Malaysia:				
Ringgit – KLSI	0.46578	0.49023	1.34583	0.23848
KLSI – Ringgit	3.28374	0.04571**	4.65351	0.02747**
Ringgit – JSI	2.73647	0.09307*	0.89381	0.45265
JSI – Ringgit	1.23588	0.27540	8.23579	0.00060***
Ringgit – MSI	3.65129	0.02663**	2.79834	0.05838*
MSI – Ringgit	0.53646	0.45346	1.63790	0.18371
Ringgit – STI	1.54671	0.36479	1.63781	0.28371
STI – Ringgit	0.98364	0.76477	0.68277	0.55723
Ringgit – BSI	2.28738	0.08497*	1.79761	0.17821
BSI – Ringgit	1.18728	0.26736	0.87287	0.56277

Notes: (1) *** indicates significant at 1% level, (2) ** indicates significant at 5% level, (3) * indicates significant at 10% level, (4) JSI is Jakarta Stock Index (Indonesia); STI is Straits Time Index (Singapore); BSI is Set Stock Index (Thailand); MSI is Manila Stock Index (Philippines) and KLSI is Kuala Lumpur Stock Index.

Singapore dollar is evident to be a strong currency in the ASEAN region. This is apparent from the test results of causality that affect changes in stock indexes in all ASEAN-five. This situation shows that the Singapore dollar had a dominant influence in the region. However, the stock index in Singapore does not significantly affect the stock indices of other countries. This fact shows that the Singapore dollar strongly affects index of stocks of other countries. Meanwhile, Singapore stock index (STI) does not affect other countries stock indexes. Even the stock index in Singapore does not affect the Singapore dollar. Therefore, the causality relationship between exchange rate and the Singapore stock index uni-directional in nature.

Johansen Co-integration Test

Table 3: Test of Johansen Co-integration between Exchange Rates and Stock Indexes-for Types of Data Created Logarithms and Percentage Change (Return)

Countries/variable	Data Logarithm		Percentage change (*return)*	
	Eigenvalue	LR ratio	Eigenvalue	LR ratio
Indonesia:				
Rupiah – JSI	0.037281	17.65255*	0.171823	152.675
Rupiah – BSI	0.032671	13.87625	0.187344	165.1625**
Rupiah – MSI	0.018272	7.67277	0.151876	143.1672**
Rupiah – STI	0.030828	9.98372	0.185637	160.4255**
Rupiah - KLSI	0.026738	8.97332	0.178737	158.0021**
Thailand:				
Baht – BSI	0.031517	12.98725	0.167378	164.8216**
Baht – JSI	0.038516	18.62761*	0.144562	134.5673**
Baht – MSI	0.021072	8.012881	0.154145	152.5631**
Baht – STI	0.019626	7.973662	0.162547	162.1325**
Baht – KLSI	0.022682	8.282633	0.151325	149.6728**
Philippines:				
Peso – MSI	0.025732	8.542563	0.178736	172.1872**
Peso – JSI	0.036915	16.16253*	0.171562	151.9861**
Peso – BSI	0.017526	7.952676	0.217827	201.0231**
Peso – STI	0.016253	7.262776	0.166752	148.2421**
Peso – KLSI	0.021456	8.142752	0.152637	143.7673**
Singapore:				
Dollar Sing – STI	0.012318	8.736721	0.161329	156.2523**
Dollar Sing – JSI	0.036742	16.56732*	0.127354	122.3461**
Dollar Sing – BSI	0.022317	15.53472	0.165241	161.6527**
Dollar Sing – MSI	0.010927	7.167370	0.152617	152.7381**
Dollar Sing – KLSI	0.021873	13.872892	0.156779	155.9627**
Malaysia:				
Ringgit – KLSI	0.022174	11.86273	0.178342	164.3722**
Ringgit – MSI	0.029982	15.72566*	0.170345	162.5626**
Ringgit – JSI	0.016982	9.652770	0.201874	200.1846**
Ringgit – BSI	0.015774	8.468726	0.168255	160.4533**
Ringgit – STI	0.018728	9.896378	0.187388	165.4887**

Notes: (1) ** indicates significant at 1% level, (2) * indicates significant at 5% level, (3) The significance level of LR test shows two co-integration equations at level5% level.

Engle and Granger (1987) showed that a linear combination between two or more non-stationary variables can be balanced. If such a balance is valid or *I*(0), those variables are said to be cointegrated. Test results of Johansen co-integration can be seen in Table 3.

Table 3 shows the co-integration test results on return data. It can be seen that all the statistics of co-integration between exchange rates and stock price index are statistically significant at 1% level. This means that in the long term there is a co-integration between all exchange rates and returns of stock prices in ASEAN-five.

Vector Autoregression (VAR)

Vector autoregression (VAR) is used to predict the systems of interrelated time series and to analyze the dynamic impact of random noise on variables system. Test results of vector autoregression (VAR) can be see in Table 4.

Table 4 shows that only lagged values of endogenous variables that appear on the right side of each equation. Therefore, there is no simultaneous issue in the equation and OLS to estimate the proper technique. Notice on the assumption that factors unrelated disorders are not limited series, because of serial correlation that can be absorbed by adding more lag factor *Y* that exists.

Table 4: Results of Vector Autoregression Estimates

Variable	Percentage of return change				
	RJSI	**RBSI**	**RMSI**	**RSTI**	**RKLSI**
LJSI(-1)	-0.129432	-0.089482	0.014729	0.015221	0.023764
	(-2.610) ***	(-1.79822)**	(0.23520)	(0.37560)	(0.76382)
LJSI(-2)	0.047896	0.000408	0.079065	0.074641	0.086226
	(0.95763)	(0.00813)	(1.25171)	(1.82610) **	(1.76376) **
LBSI(-1)	0.065322	-0.038056	0.117418	0.037938	0.031268
	(1.3114) *	(-0.76059)	(1.86472) **	(0.93106)	(0.87266)
LBSI(-2)	0.045980	0.098430	0.134182	0.065291	0.076621
	(0.94716)	(2.02047) **	(2.18861) **	(1.64571) **	(1.78271) **
LMSI(-1)	0.087776	0.082434	0.108450	0.027014	0.189214
	(2.269) **	(2.12069) **	(-2.2169) **	(0.85337)	(0.65257)
LMSI(-2)	0.055039	0.051664	-0.055836	-0.066045	-0.066045
	(1.4560) *	(1.36193) *	(-1.16959)	(-2.13785) **	(-1.76285) **
LSTI(-1)	0.015847	0.280478	0.328153	0.068353	0.067745
	(0.24828)	(4.3788) ***	(4.0703)***	(1.31031) *	(1.45231) *
LSTI(-2)	0.025238	-0.013224	0.243362	0.022159	0.032619
	(0.38422)	(-0.20061)	(2.9336)***	(0.41278)	(0.56277)
LKLSI(-1)	0.026377	0.271422	0.298353	0.037483	0.129336
	(0.45822)	(4.3876) ***	(4.1283)***	(1.42931) *	(1.45526) *
LKLSI(-2)	0.032298	-0.187724	0.262562	0.164559	0.056733
	(0.38873)	(-0.31061)	(2.8562)***	(0.48238)	(0.67377)
LRUPIAH	-0.104016	-0.077625	0.079997	0.078629	0.078629
	(-1.698) **	(-1.26321)	(1.03442)	(1.57119) *	(1.57119) *
LBAHT	-0.069658	-0.119119	-0.063682	0.029291	0.029291
	(-0.87438)	(-1.48997) *	(-0.63294)	(0.44990)	(0.44990)
LPESO	-0.052048	-0.028678	-0.950545	-0.138229	-0.138229
	(-0.67326)	(-0.36965)	(-9.7358) ***	(-2.18786) **	(-2.18786) **
LDOLLAR	-0.020332	-0.030155	0.047640	-0.037796	-0.037796
	(-0.83515)	(-1.23429)	(1.54948) *	(-1.89967) **	(-1.89967) **
LRINGGIT	-0.031762	-0.032765	0.103740	-0.054166	-0.037668
	(-1.17715)	(-1.27259)	(1.66788) *	(-1.96728) **	(-1.82873) **

Notes: (1) *** indicates significant at 1% level; (2) ** indicates significant at 5% level; (3) * indicates significant at 10% level; (4) Entries in parentheses are calculated values compared to the critical values.

Vector Error Correction Model (VECM)

Table 5: Results of Analysis of Vector Error Correction

Error Correction:	D(RJSI)	D(RBSI)	D(RMSI)	D(RSTI)	D(RKLSI)
CointEq1	-0.008476	0.003425	-0.056212	0.027092	0.054256
	(0.00342)	(0.07626)	(0.00562)	(0.02456)	(0.01234)
	(-1.52671)	(0.06274)	(-10.2596)	(3.67277)	(2.56266)
D(RJSI(-1))	-0.756281	-0.095194	0.059609	-0.008435	0.027675
	(0.04726)	(0.04710)	(0.05550)	(0.03788)	(0.04516)
	(-16.4536)	(-2.02098)	(1.07403)	(-0.22270)	0.562771
D(RJSI(-2))	-0.383620	-0.056949	0.150793	0.060918	0.134258
	(0.04183)	(0.04637)	(0.05464)	(0.03729)	(0.08567)
	(-7.92877)	(-1.22814)	(2.75992)	(1.63369)	(1.45266)
D(RBSI(-1))	0.045637	-0.722976	-0.123817	0.030505	0.055425
	(0.08376)	(0.04879)	(0.05749)	(0.03924)	(0.06728)
	(0.68083)	(-14.8179)	(-2.15375)	(0.77748)	(0.35678)
D(RBSI(-2))	0.028376	-0.280349	-0.053348	0.029904	0.022784
	(0.04839)	(0.04689)	(0.05525)	(0.03771)	(0.09822)
	(0.56738)	(-5.97837)	(-0.96550)	(0.79302)	(0.37482)
D(RMSI(-1))	0.078388	0.048745	-0.087505	-0.161249	-0.183349
	(0.07388)	(0.06118)	(0.07208)	(0.04920)	(0.28720)
	(1.63456)	(0.79679)	(-1.21393)	(-3.27770)	(-4.77378)
D(RMSI(-2))	0.045662	0.070651	-0.084019	-0.151506	-0.347809
	(0.05735)	(0.04163)	(0.04905)	(0.03348)	(0.06535)
	(1.45366)	(1.69712)	(-1.71286)	(-4.52570)	(-5.22870)
D(RSTI(-1))	-0.354633	0.230941	-0.794436	-0.339515	-0.367225
	(0.05366)	(0.09758)	(0.11498)	(0.07847)	(0.11928)
	(-1.45264)	(2.36658)	(-6.90923)	(-4.32655)	(-3.67355)
D(RSTI(-2))	-0.128736	0.114713	-0.324053	-0.128301	-0.115626
	(0.07723)	(0.07135)	(0.08406)	(0.05737)	(0.25652)
	(-1.65619)	(1.60785)	(-3.85480)	(-2.23629)	(-1.25622)
D(RKLSI(-1))	0.085366	0.046738	-0.076277	-0.172849	-0.256227
	(0.05592)	(0.05627)	(0.06728)	(0.04256)	(0.26782)
	(1.52766)	(0.78736)	(-1.32655)	(-3.17266)	(-4.67288)
D(RKLSI(-2))	0.036721	0.080301	-0.078289	-0.162552	-0.246366
	(0.05632)	(0.05366)	(0.05627)	(0.03562)	(0.03848)
	(1.35276)	(1.71829)	(-1.73772)	(-4.25897)	(-5.15426)
C	6.73E-04	1.03E-05	0.000339	-1.88E-06	-1.88E-06
	(0.00012)	(0.00034)	(0.00040)	(0.00028)	(0.00028)
	(0.16451)	(0.02992)	(0.83850)	(-0.00683)	(-0.00683)
RRUPIAH	-0.083467	-0.060392	0.097684	0.087777	0.087777
	(0.06377)	(0.07080)	(0.08342)	(0.05693)	(0.05693)
	(-1.19872)	(-0.85305)	(1.17104)	(1.54184)	(1.54184)
RBAHT	0.000387	-0.045782	0.007761	0.074506	0.074506
	(0.08474)	(0.09086)	(0.10706)	(0.07307)	(0.07307)
	(0.00251)	(-0.50387)	(0.07249)	(1.01970)	(1.01970)
RPESO	-0.002961	0.045030	-0.917704	-0.093501	-0.093501
	(0.08728)	(0.08907)	(0.10494)	(0.07162)	(0.07162)
	(-0.04255)	(0.50558)	(-8.74468)	(-1.30548)	(-1.30548)
RDOLLARSING	-0.029378	-0.026756	0.028354	-0.053046	-0.053046
	(0.03450)	(0.02795)	(0.03293)	(0.02248)	(0.02248)
	(-0.73626)	(-0.95727)	(0.86096)	(-2.36010)	(-2.36010)
LRINGGIT	-0.04526	0.053674	-0.898284	-0.072881	-0.637741
	(0.06253)	(0.07365)	(0.24536)	(0.06277)	(0.10927)
	(-0.04561)	(0.51762)	(-0.67272)	(-1.29836)	(-1.23908)
R-squared	0.456324	0.416752	0.587364	0.387366	0.345637
Adj. R-squared	0.415671	0.383564	0.528745	0.305367	0.328612
Sum sq. resids	0.029765	0.030311	0.042082	0.019601	0.019601
S.E. equation	0.007685	0.007755	0.009138	0.006236	0.006236
Log likelihood	1793.967	1789.263	1704.281	1902.170	1902.170
Akaike AIC	1794.021	1789.317	1704.335	1902.224	1902.224
Schwarz SC	1794.136	1789.432	1704.450	1902.339	1902.339
Mean dependent	1.36E-07	-4.55E-06	8.31E-07	-4.62E-06	-4.62E-06
S.D. dependent	0.010053	0.009949	0.013383	0.007545	0.007545

VECM is a restricted VAR which has a limitation of cointegration. Therefore, this model is designed for non-balanced series which are cointegrated. The specification of VEC restricts the cointegration relationship while allowing sort term dynamics. Cointegration is known as a representation of error correction because the deviation from long term equilbrium is corrected in steps through a series of long term adjustments. The results of VECM is available in Table 5.

Table 5 shows that most of the cointegration between exchange rates and stock price index was not significantly associated with a reduction in acquisition rate. For example, the coefficients of cointegration equations are significant for MSI and STI but not for JSI or BSI and KLSI. Cointegration between Peso/USD and Manila Composite Index is improved with the revenue in Peso/USD of 92%. Cointegration between Peso/USD and BSI is improved with the revenue in Peso/USD of 5%. There is no corrction which is statistically significant for cointegration between the rest of the markets for those exchange rates.

CONCLUSION

The purpose of this study was primarily to test the causality between the exchange rate with the stock price index in the ASEAN-five (Indonesia, Singapore, Thailand, the Philippines and Malaysia) using Engle-Granger causality test and co-integration test of Johansen. The research was conducted for the period of 1993 to 2006. The first step in the data analysis was conducting unit root tests to determine stationarity of data to be used, then followed by testing causal relationships between exchange rates and stock prices with Engle-Granger causality test. To determine whether the relationship between exchange rates and stock prices took place in the short term or long-term, Johansen co-integration tests was conducted. The final step was estimating the Vector Autoregression (VAR) and Test Vector Error Correction Mechanism (VECM).

The main results of this study suggested that the causality in both directions (bi-directional) and one direction (unidirectional) present in the regression models linking exchange rates with stock prices or stock prices with exchange rates. The results from Engle-Granger causality tests showed that the data in both natural logarithm and return data did not provide significant different results. The results showed that two-way causality relationship are evident only between the value of the currency and the Jakarta Stock Index (JSI). Bi-directional causalty across countries was evident between Peso and BSI, and between Singapore Dollar and BSI. The Singapore Dollar was found to be the strongest currency in ASEAN. Singapore Dollar also had bidirectional causality with MSI and KLSI.

The long term relationship between exchange rates and stock price was tested using Johansen cointegration procedure. The results from the bivariate model using Johansen procedure showed that for return data, there was an evident of cointegration between stock price index and exchange rates for all countries in the study. VAR analysis showed that each stock price index is explained by other stock price indices. The results showed that there existed a cointegration between stock markets in the five countries. In addition, based on percentage change data (return), there existed cointegration between stock price and exchange rates. The analysis also suggested that stock price and exchange rates were not suitable to improve deviation in the long run relationship, except for the correction of Singapore Dollar for STI and Rupiah correction for JSI.

The use of Ordinary Least Squares in time series economic might resulted in spurious results. Therefore, the use of Engle-Granger causality method in this research was more appropriate.

Some recommendations are proposed in this paper: (1) The results can be used as a reference in the study causality between exchange rates and stock prices. (2) Future research regarding the causality between exchange rates and stocks price would be better if accompanied by other relevant control variables, such as economic variables which might influence exchange rates of stock prices. (3) Future researches might confirm the suggestions in this study by analyzing other stock index and currencies from other countries.

REFERENCES

Abdalla, I.S.A. and V. Murinde (1997), "Exchange Rates and Stock Prices Interaction in Emerging Financial Markets: Evidence on India, Korea, Pakistan, and the Philippines," *Applied Financial Economics*, 7, 25-35.

Aggarwal, R. (1981), "Exchange Rates and Stock Prices: A study of the US Capital Markets under Floating Rates," *Akron Business and Economic Review*, 12, 7-12.

Ajayi, R.A., J. Friedman, and S.M. Mehdian (1998), "On the Relationship between Stock Returns and Exchange Rates: Tests of Granger Causality," *Global Finance Journal*, 9, 241-251.

Bahmani-Oskooee, M. and A. Sohrabian (1992), "Stock Prices and the Effective Exchange Rates of the Dollar," *Applied Economics*, 24, 459-464.

Bodnar, G.M., and W.M. Gentry (1993), "The Exchange Rates Exposure and Industry Characteristics: Evidence from Canada, Japan and the US," *Journal of International Money and Finance*, 12, 29-45.

Dickey, D.A. and W.A. Fuller (1979), "Distribution of the Estimators for Autoregression Time Series with a Unit Root," *Journal of American Statistic Association*, 74, 427-431.

Doong, S.C., S.Y. Yang, and A.T. Wang (2005), "The Dynamic Relationship and Pricing of Stocks and Exchange Rates: Empirical Evidence from Asian Emerging Markets," *Journal of American Academy of Business*, 7(1), 123-135.

Engle, R.F. and C.W. Granger (1987), "Co-integration and Error Correction: Representation, Estimation and Testing," *Econometrica*, 55, 251–276.

Granger, C.W. (2000), "A Bivariate Causality between Stock Price and Exchange Rates: Evidence from Recent Asian Flu," *Quarterly Review of Economics and Finance*, 21(2), 43-58.

Harjito, D.A. (2006), "Hubungan Nilai Tukar dan Harga Saham di Pasar Modal Malaysia: Pendekatan Statistik Non-parametrik," *Jurnal Ekonomi dan Bisnis-EKOBI*, 7(2), 257-279.

Harjito, D.A. and C.B. McGowan (2007), "Stock Price and Exchange Rate Causality: The Case of Four ASEAN Countries," *Southwestern Economic Review*, 34(1), 103-114.

Ibrahim, M.H. (2000), "Cointegration and Granger Causality Test of Stock Prices and Exchange Rates Interactions in Malaysia," *ASEAN Economic Bulletin*, 17, 36-47.

Johansen, S. (1988), "Statistical Analysis of Cointegration Vectors," *Journal of Economics Dynamic Control*, 12, 231–254.

Jorion, P. (1990), "The Exchange Rates Exposure of US. Multinationals," *Journal of Businness*, 63, 331-345.

Krueger, A.O. (1983), *Exchange Rates Determination*, Cambridge University Press, Cambridge.

Phylaktis, K. and F. Ravazzolo (2002), *Stock Price and Exchange Rate Dynamics*, London, City University Business School.

Solnik, B.H. (1984), "Stock and Money Variabels: The International Evidence," *Financial Analyst Journal*, 69-73.